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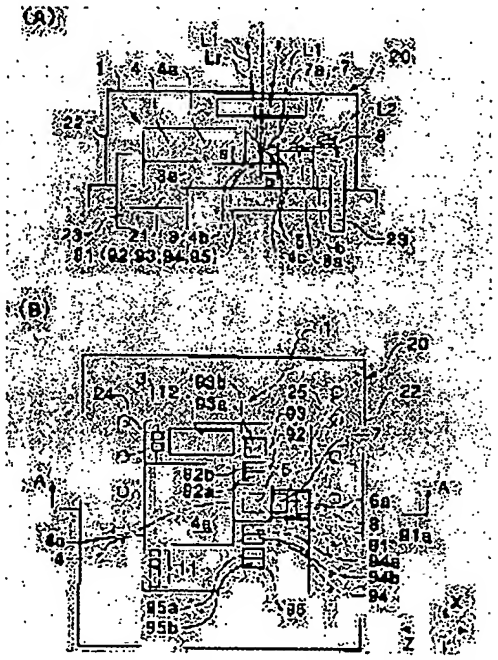
(54) SEMICONDUCTOR LASER MODULE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a semiconductor laser module provided with constitution capable of simply performing bonding work.
SOLUTION: In the semiconductor laser module 1, a prism 4 and a sub-mount 6 are arranged on a surface 3a of a semiconductor substrate 3. A reflection film 5 is formed on the slope of the prism 4, and a semiconductor laser chip 7 is mounted on the surface 6a of the sub-mount 6 opposite to that, and a monitoring photodiode chip 8 is mounted on the rear of the semiconductor laser chip 7. Signal processing photodiodes 91 to 95 are made into the semiconductor substrate surface 6a, and the central photodiode 91 is placed just under the reflection film 5. Since terminal pads 11 formed on the semiconductor substrate surface 3a, and the semiconductor laser chip 7 and photodiode chip 8 mounted on the sub-mount surface 6a are placed on parallel planes, the wire bonding work for electrically connecting them to the outside is performed simply and with a good yield.



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* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] The semiconductor laser module which has the semiconductor laser chip characterized by providing the following, the reflector which reflects the laser beam by which outgoing radiation was carried out from the semiconductor laser chip concerned, the photo detector for signal processing which receives the return light of the aforementioned laser beam, and the photo detector for monitors which receives the laser beam by which outgoing radiation was carried out from the aforementioned semiconductor laser chip The semiconductor substrate equipped with the flat front face Prism equipped with the aforementioned reflector which has been arranged on the front face of the semiconductor substrate concerned, and inclined 45 abbreviation to the front face concerned Sub mounting which has been arranged on the front face of the aforementioned semiconductor substrate so that face to face may be stood against the aforementioned reflector of the prism concerned, and was equipped with the front face parallel to the front face of the semiconductor substrate concerned The aforementioned photo detector for signal processing made by the semiconductor substrate concerned so that at least one light-receiving side may be formed in the front face of the aforementioned semiconductor substrate in which it is located directly under the aforementioned semiconductor-laser chip arranged on the front face of the aforementioned sub mounting so that the main laser beam may irradiate to the aforementioned reflector of the aforementioned prism, the aforementioned photo detector for monitors which have been arranged on the front face of the aforementioned sub mounting so that the sublaser beam by which outgoing radiation is carried out from the semiconductor-laser chip concerned may receive, and the reflector of the aforementioned
[Claim 2] The semiconductor laser module which has the semiconductor laser chip characterized by providing the following, the reflector which reflects the laser beam by which outgoing radiation was carried out from the semiconductor laser chip concerned, the photo detector for signal processing which receives the return light of the aforementioned laser beam, and the photo detector for monitors which receives the laser beam by which outgoing radiation was carried out from the aforementioned semiconductor laser chip The semiconductor substrate equipped with the flat front face Prism equipped with the aforementioned reflector which has been arranged on the front face of the semiconductor substrate concerned, and inclined 45 abbreviation to the front face concerned Sub mounting which has been arranged on the front face of the aforementioned semiconductor substrate so that face to face may be stood against the aforementioned reflector of the prism concerned, and was equipped with the front face parallel to the front face of the semiconductor substrate concerned The aforementioned semiconductor laser chip arranged on the front face of the aforementioned sub mounting so that the main laser beam may be irradiated to the aforementioned reflector of the aforementioned prism, The aforementioned photo detector for monitors made by the semiconductor substrate concerned so that a light-receiving side might be located in the irradiation field of the front face of the aforementioned semiconductor substrate by the incident-light component of the main laser beam which carried out incidence into the aforementioned prism through the aforementioned reflector, The aforementioned photo detector for signal processing made by the semiconductor substrate concerned so that at least one light-receiving side might be formed in the front face of the aforementioned semiconductor substrate located directly under the reflector of the aforementioned prism

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[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the semiconductor laser module of composition of that the laser light source and the photodetection section suitable for using it for the optical pickup for performing reproduction and record of an optical recording medium, or one [those] operation etc. were incorporated in one.
[0002]
[Description of the Prior Art] The optical pickup for reproducing optical recording media, such as a compact disk (CD), makes the recording surface of an optical recording medium condense the outgoing radiation light from the laser diode which is a laser light source through an objective lens, and has the composition of reading the return light from the recording surface concerned by the light sensitive cell. Moreover, the mechanism which can be amended minute is incorporated in the direction of a TORRA king, and the direction of focusing in the position of an objective lens so that outgoing radiation light may condense on the truck on a target recording surface correctly through an objective lens. In order to perform amendment of such a direction of tracking, and amendment of the direction of focusing, outgoing radiation light is diffracted with three beams, and it is made to acquire the servo control signal for tracking amendment, and the servo control signal for focusing amendment from the return light from an optical recording medium using diffraction gratings, such as a hologram optical element.
[0003] In order that an optical pickup may realize the small lightweight-ization, improvement is made about small lightweight-ization of a component. Among these, the composition which attained small lightweight-ization is proposed by attaching a laser light source and a light sensitive cell in one.
[0004] For example, the photo-detector package (semiconductor laser module) of composition of that a semiconductor laser chip and the photo diode which is a photo detector for tracking and focusing were enclosed in the package is indicated by JP,7-70065,B. In the photo-detector package indicated here, a heat sink is attached in the front face of a stem to which the lead pin has come out from the rear-face side, and the photo diode chip and the semiconductor laser chip are arranged at the upper surface and the side of this heat sink, respectively. The electrode of each of these chips is electrically connected to the lied terminal arranged at the periphery of a heat sink etc. by wirebonding, and transfer of a signal is performed between external circuits through the lead pin by the side of a stem rear face.
[0005]
[Problem(s) to be Solved by the Invention] In the semiconductor laser module of the above-mentioned composition, the semiconductor laser chip is attached in the side which intersects perpendicularly to the front face of the heat sink with which the photo diode chip has been arranged. In wirebonding, even if the difference of elevation is in the flat surface in which the parts for bonding are attached, when those fields are parallel, it does not become almost at the hindrance of mounting work.
[0006] However, when the parts for bonding are attached in the front face which is not parallel, respectively, in the bonding of these parts, it is necessary to change the posture of a bonding machine according to it. For example, when the phot die auto chip and semiconductor laser chip for bonding are arranged on the flat surface which intersects perpendicularly as mentioned above, after carrying out bonding of one near parts, it is necessary to change the posture of a bonding machine 90 degrees and to perform bonding of the remaining parts. Or it is necessary to mount in the field which intersects perpendicularly using the complicated bonding machine equipped with the capillary tube in which bonding is possible.
[0007] Thus, since the work is difficult, not to mention carrying out a yield fall, carrying out bonding of the parts arranged on the flat surface which is not parallel will take mounting time mostly, and it will become the hindrance of reduction-izing of a product price.
[0008] The technical problem of this invention is to propose the semiconductor laser module equipped with the possible composition of canceling such a conventional trouble.
[0009]
[Means for Solving the Problem] In order to solve the above-mentioned technical problem, it is made for the next composition to be used for this invention in the semiconductor laser module which has a semiconductor laser chip, the reflector which reflects the laser beam by which outgoing radiation was carried out from the semiconductor laser chip concerned, the photo detector for signal processing which receives the return light of the aforementioned laser beam, and the photo detector for monitors which receives the laser beam by which outgoing radiation was carried out from the aforementioned semiconductor laser chip. Namely, the semiconductor substrate equipped with the flat front face and prism

equipped with the aforementioned reflector which has been arranged on the front face of the semiconductor substrate concerned, and inclined 45 abbreviation to the front face concerned, Sub mounting which has been arranged on the front face of the aforementioned semiconductor substrate so that face to face may be stood against the aforementioned reflector of the prism concerned, and was equipped with the front face parallel to the front face of the semiconductor substrate concerned, The aforementioned semiconductor laser chip arranged on the front face of the aforementioned sub mounting so that the main laser beam may be irradiated to the aforementioned reflector of the aforementioned prism, The aforementioned photo detector for monitors arranged on the front face of the aforementioned sub mounting so that the sublaser beam by which outgoing radiation is carried out from the semiconductor laser chip concerned may be received, The composition which has the aforementioned photo detector for signal processing made by the semiconductor substrate concerned so that at least one light-receiving side might be formed in the front face of the aforementioned semiconductor substrate located directly under the reflector of the aforementioned prism is adopted.

[0010] Moreover, the semiconductor substrate which the semiconductor laser module of this invention equipped with the flat front face instead of the above-mentioned composition, The prism equipped with the aforementioned reflector which has been arranged on the front face of the semiconductor substrate concerned, and inclined 45 degrees to the front face concerned, Sub mounting which has been arranged on the front face of the aforementioned semiconductor substrate so that face to face may be stood against the aforementioned reflector of the prism concerned, and was equipped with the front face parallel to the front face of the semiconductor substrate concerned, The aforementioned semiconductor laser chip arranged on the front face of the aforementioned sub mounting so that the main laser beam may be irradiated to the aforementioned reflector of the aforementioned prism, The aforementioned photo detector for monitors made by the semiconductor substrate concerned so that a light-receiving side might be located in the irradiation field of the front face of the aforementioned semiconductor substrate by the incident-light component of the main laser beam which carried out incidence into the aforementioned prism through the aforementioned reflector, The composition which has the aforementioned photo detector for signal processing made by the semiconductor substrate concerned so that at least one light-receiving side might be formed in the front face of the aforementioned semiconductor substrate located directly under the reflector of the aforementioned prism is adopted.

[0011] Thus, in the semiconductor laser module of the constituted this invention, each component part can be arranged on an parallel flat surface. Therefore, by easy work, the yield is good and, moreover, bonding of each component part can be performed in a short time. For this reason, it is advantageous also to reduction-izing of an equipment price.

[0012]

[Embodiments of the Invention] The semiconductor laser module which applied this invention to below with reference to the drawing is explained.

[0013] As shown in drawing 1 , the semiconductor laser module 1 of this invention is enclosed with a package 20, and is used as a semiconductor laser unit. Of course, it may use without carrying out the closure packaging of the laser module 1. The package 20 of this example is equipped with the support substrate (stem) 21, and the cup-like cap 22 for closure who attached on this. The semiconductor laser module 1 which applied this invention on the front face of the support substrate 21 is carried in the closure space formed of these. The lead pin 23 is attached in the stem 21, and transfer of a signal is performed through the lead pin group 23 between each component of the semiconductor laser module 1 and the exteriors which are enclosed.

[0014] The semiconductor laser module 1 is equipped with the semiconductor substrate 3 arranged on the front face of the support substrate 21, and this front face has become flat field 3a. Prism 4 is arranged at this flat surface 3a. the right angle from the center of rectangle board partial 4a of thickness with fixed prism 4, and side 4b of one of these -- projection -- it has lobe part 4c the bottom, the upper surface of this lobe part 4c is made into the slant face which makes the angle of 45 degrees to surface 3a of the semiconductor substrate 3, and this slant face is the reflector in which the reflective film 5 was formed The degree of tilt angle of a reflector does not need to be 45 degrees strictly, and should just be 45 degrees in general. Let prism 4 be glass mould parts or resin mould parts.

[0015] The plate-like sub mounting 6 which functions as a heat sink is arranged in the position of semiconductor substrate surface 3a which stands face to face against this reflective film 5. The upper surface of this sub mounting 6 is semiconductor substrate surface 3a and parallel flat surface 6a. The semiconductor laser chip 7 is arranged at the near portion of the reflector 5 in this surface 6a. The emitting [main laser beam] light point 7a stands face to face against the reflector 5 so that the semiconductor laser chip 7 may serve as sense in which the main laser beam L1 by which outgoing radiation is carried out carries out incidence from there at the angle of 45 degrees to a reflector 5.

[0016] The photo diode chip 8 as a photo detector for monitors is arranged at the portion of surface 6a of the sub mounting 6 by the side of the tooth back of the semiconductor laser chip 7. With this photo diode chip 8, the sublaser beam L2 which carries out outgoing radiation from the semiconductor laser chip 7 can be received.

[0017] The semiconductor substrate 3 is a photo diode substrate for constituting the photo detector for signal processing, and the photo diode 91 for a semiconductor manufacture process detecting a pit signal from the return light Lr from an optical recording medium and four photo diodes 92, 93, 94, and 95 of two assembled dies arranged by the both sides of this photo diode 91 are formed here. Light-receiving side 91a of the photo diode 91 located in the center such photo diodes 91 or among 95 is formed in the portion of surface 3a of the semiconductor substrate 3 located directly under the reflector 5 of prism 4. Thus, in this example, it has five photo diodes 91 or 95 as a photo detector for signal processing.

[0018] Here, the terminal pad group 11 for taking out photo diode 91 or the output from 95 is formed in the periphery portion of surface 3a of the semiconductor substrate 3, and each of these terminal pad groups 11 is electrically connected to the lead pin by which two or more lead pin groups 23 attached in the state where the periphery portion of a support plate (stem) 21

was penetrated by wirebonding 24 correspond.
[0019] Moreover, the photo diode chip 8 and the semiconductor laser chip 7 are also electrically connected to the lead bottle by which it corresponds of the lead pin groups 23 by wirebonding 25, and a signal is taken out outside through a lead pin group, or power is supplied from the exterior.
[0020] (Optical pickup) An example of the optical system of an optical pickup with which the semiconductor laser module 1 of the above-mentioned composition was incorporated is shown in drawing 2 .
[0021] In the optical system of the optical pickup of this example, the straight-line-like optical path is formed between the semiconductor laser units 30 and the optical recording media 31 by which the semiconductor laser module 1 was built in. the optical-path top of the shape of this straight line -- the hologram element 32 from a side, 1/4 wavelength plate 33, and objective lens 34 of the semiconductor laser module 1 -- this sequence -- an array -- now, it is The hologram element 32 is formed in the optical axis Lo and the front face of the glass substrate 35 arranged mostly at the perpendicular.
[0022] It is reflected right-angled by the reflector 5 by which opposite arrangement is carried out, and outgoing radiation of the main laser beam L1 by which outgoing radiation was carried out from the semiconductor laser chip 7 in the semiconductor laser module 1 is carried out from the semiconductor laser unit 30 towards the direction which met the optical axis Lo. The main laser beam L1 passes a glass substrate 35, and is divided into five light beams by the hologram element 32. Such division light is led to an objective lens 34 through 1/4 wavelength plate 33, and converges as five optical spots on the recording surface of the optical recording medium 31 through an objective lens 34.
[0023] It is reflected by the recording surface and the return light Lr of five light beams reflected by the recording surface of a record medium 31 passes 1/4 wavelength plate 33 through an objective lens 34 again. It returns by 1/4 wavelength plate 33, and plane of polarization rotates light 90 degrees. Therefore, the hologram element 32 is passed as it is, and it returns to the semiconductor laser module 1 through a glass substrate 35.
[0024] Five light beams which returned to the semiconductor laser module 1 are detected by five photo diodes 91 currently formed in the semiconductor substrate 3, or 95, and a focusing error signal, a tracking error signal, and RF signal are detected. Here, since the reflector 5 is formed in right above [of the central photo diode 91], the light which passed the reflector 5 will irradiate this photo diode 91.
[0025] On the other hand, the sublaser beam L2 which carried out outgoing radiation from the tooth-back side of the semiconductor laser chip 7 irradiates the photo diode 8 for monitors by which opposite arrangement is carried out at the tooth-back side of the semiconductor laser chip 7, and is detected here. Based on the detecting signal of this photo diode 8, the output control of the semiconductor laser chip 7 is performed. That is, quantity of light adjustment of the outgoing radiation light L1 is performed.
[0026] Thus, in this example, the signal detection is performed by dividing outgoing radiation light into five light beams with the hologram element 32.
[0027] With reference to drawing 3 or drawing 6 , an operation of the hologram element 32 and a signal-detection principle are explained.
[0028] First, as shown in drawing 3 , the hologram element 32 is halved by the parting line prolonged in the direction which meets the truck of a record medium 31 on an optical axis Lo mostly, and the direction which intersects perpendicularly. The diffraction gratings (irregularity-like grid) 32A and 32B of a couple with which diffraction conditions differ bordering on this parting line are formed. As for these diffraction gratings 32A and 32B, the lattice spacing differs from the direction of a grid.
[0029] It explains as which position on a recording surface it is completed by the light beam of diffraction zero-order and the primary diffraction by operation of this hologram element 32 using the principle view of drawing 3 . The zero-order light which is not diffracted among the light beams which carried out outgoing radiation from the semiconductor laser module 1, and which carried out incidence to upper hologram element 32A passes diffraction-grating 32A, it carries out incidence to an objective lens 34, and it is converged on point L'. Incidence of it is carried out to an objective lens 34 as if the primary diffraction light which received diffraction had the light source in virtual-image A+ which is in the optical-axis symmetry centering on the position L of the semiconductor laser module 1, and A-, and it is converged on point A'+, A'-. namely, the light beam which carried out outgoing radiation of the diffraction-grating 32A -- an objective lens 34 -- zero-order light -- being related -- L and conjugate point L' -- primary light -- being related -- A+, and conjugate-point A'+, A'- ** -- it converges on the position (conjugate point) where it corresponded on the recording surface, respectively [of A-]
[0030] The light beam which carried out outgoing radiation from the semiconductor laser module 1 and which carried out incidence to diffraction-grating 32B of the drawing 6 bottom can completely be considered to be this the same way. About primary light, it converges on point L' [conjugate / light / zero-order] as L / at B+, and conjugate-point B'+, B'-, respectively. / of B- Therefore, after the outgoing radiation light of the semiconductor laser module 1 serves as diffraction zero-order and a light beam of the primary diffraction and passes an objective lens 34 by operation of the diffraction gratings 32A and 32B of the upper and lower sides of the hologram element 32, it will be converged on the recording surface of the optical recording medium 31 as five optical spots of L', A'+, A'-, and B'+, B'-.
[0031] Signs that the optical spot formed was perpendicularly seen to the recording surface of the optical recording medium 31 are shown in drawing 4 . The optical spot 100 of the center of a truck 311 is diffraction zero-order light, and four points of others are the primary [**] diffracted lights. In addition, the light beam which passed the portion in which a diffraction grating is not formed with the hologram element 32 is converged on the same optical spot as diffraction zero-order light. Here, the primary diffraction light spots 101 and 103 of diffraction-grating 32A become the position of a point symmetry to the main optical spot 100, and the primary diffraction light spots 102 and 104 of diffraction-grating 32B also become the

position of a point symmetry to the main optical spot 100. Each spot position can complete each primary diffracted light as the suitable position of a truck by appointing each lattice spacing and direction of a grid of each diffraction gratings 32A and 32B. Moreover, the outline configuration of the optical spot of these primary diffraction light is acquired as the Fourier transform of each diffraction-grating opening configuration.

[0032] Next, the optical spot received in the photo diode 9 (91 or 95) which is a light sensitive cell is explained. It reflects by the optical recording medium 31, and the optical spot on the recording surface of the optical recording medium 31 passes an objective lens 34 again, and it carries out re-image formation by the near focal plane of photo diode 9. The physical relationship of the optical spot in the near focal plane of photo diode 9 turns into the physical relationship and the conjugate relation of an optical spot on a recording surface. Therefore, when the physical relationship of an objective lens 34 and the optical recording medium 31 moves in the direction which intersects perpendicularly with the direction of an optical axis, or an optical axis, a spot position and a spot configuration change similarly on a recording surface and the focal plane by the side of the photo diode group 8.

[0033] With reference to drawing 5 , change of the direction of an optical axis of the physical relationship of an objective lens 34 and the optical recording medium 31, i.e., change of the near optical spot of the photo diode 9 to a focal gap, is explained.

[0034] At the focusing point, as shown in drawing 9 (B), focusing on the optical spot 200 of zero-order light, the optical spots 201 and 203 of the primary diffraction light of diffraction-grating 32A and the optical spots 202 and 204 of the primary diffraction light of diffraction-grating 32B are located up and down, and all form the minimum optical spot. And it is located at the center of the parting line of 2 division photo diode 92 or 2 division light-receiving side of 95 where the optical spot 201 of primary diffraction light or 204 arranged the optical spot 200 in the single tier at the both sides of photo diode 91 at the center of light-receiving side 91a of the central photo diode 91.

[0035] On the other hand, when the distance of an objective lens 34 and the optical recording medium 31 approaches, as shown in drawing 5 (A), the optical spot 200 of zero-order light does not have change of a position, and a path becomes large. while the optical spots 201 and 203 of the primary diffraction light of diffraction-grating 32A become large in the form similar to the opening configuration of diffraction-grating 32A -- the center -- the drawing 5 top -- moving .

[0036] The center moves the optical spots 202 and 204 of the primary diffraction light of diffraction-grating 32B to the drawing 5 bottom, becoming large in the form similar to the opening configuration of diffraction-grating 32B. Consequently, as for the optical spot 201 of primary diffraction light, or 204, most will be located in each one side of 2 division photo diode 92 or 95. In addition, since drawing 5 has shown the ideal state, although the optical spot is located only in one side, a part is located also in an another side side by dotage etc. in practice.

[0037] With the above, when the distance of an objective lens 34 and an optical recording medium becomes far conversely, as shown in drawing 5 (C), the optical spot 200 of zero-order light does not have change of a position, and a path becomes large. the optical spots 201 and 203 of the primary diffraction light of diffraction-grating 32A -- the upper and lower sides of diffraction-grating 32A -- while becoming large in the form similar to the reverse opening configuration -- the center -- the drawing 5 bottom -- moving . The center moves the optical spots 202 and 204 of the primary diffraction light of diffraction-grating 32B to the drawing 5 bottom, becoming large in the form similar to the opening configuration of the vertical reverse of diffraction-grating 32B.

[0038] Therefore, if it is made for a comparator 403 to compare the result for the output of 2 division photo diodes 92 and 93, and the output of 2 division photo diodes 94 and 95 by comparators 401 and 402 among each photo diode 91 or the output of 95 as compared with vertical reverse, respectively as shown in drawing 6 , a focusing error signal (FE signal) can be obtained.

[0039] On the other hand, it is the same as that of the usual 3 beam method, and as shown in drawing 6 , a tracking error signal (TE signal) can be acquired by adding the output of 2 division photo diodes 92 and 93, and the output of 2 division photo diodes 94 and 95 with adders 404 and 405, respectively, and comparing the result by the comparator 406. But a tracking error signal can obtain at least the output of 2 division photo diodes 92 and 94, or the output of 2 division photo diodes 93 and 95.

[0040] In addition, about RF signal, according to the grade of focusing, it is only that the beam diameter of zero-order light fluctuates, and the spot is always located on the light-receiving side of photo diode 91. Detection of RF signal is performed based on the output of this photo diode 91.

[0041] Here, the preparation of the arrangement position of each portion of the semiconductor laser module 1 is explained.

[0042] In the optical system of the optical pickup of the above-mentioned composition, the physical relationship between emitting light point 7a of the semiconductor laser chip 7 and the light-receiving side of the photo diode group 9 for signal processing turns into conjugate physical relationship optically. That is, the optical path lengths a and b in drawing 1 (A) become equal length. If these portions shift from the position which has a conjugate relation, the so-called focal offset from which the zero position of the point and a focal error signal where the modulation intensity of FR (pit) signal serves as the highest shifts will arise.

[0043] Adjust the optical path length a, and it is made for this to serve as the optical path length b and a conjugate relation, and is made to fix prism 4 to the position where the conjugate relation was materialized in the semiconductor laser module 1 of this example by setting prism 4 on surface 3a of the semiconductor substrate 3, and making it move in the direction (Z direction of drawing 1) approached and estranged to the semiconductor laser chip 7. Thus, whenever it adjusts, when a thickness error is in the sub mounting 6, it can be compensated, and both portions can be set as the position used as a conjugate relation, for example.

[0044] Moreover, in order to make it focal offset not occur, the above-mentioned case is required also for positioning of the semiconductor laser chip 7 in the direction (the direction of X of drawing 1) which intersects perpendicularly. for this reason -- being alike -- what is necessary is to be in the state where the semiconductor laser chip 7 was made to emit light, to turn this in the direction of X together with the sub mounting 6, and just to move it so that the spot of each beam of the return light Lr may be located at the center on the parting line in the halved type photo diode 92 or the light-receiving side of 95
[0045] Thus, in the semiconductor laser module 1 of this example, by moving all around the prism 4 and the sub mounting 6 which are arranged to flat surface 3a of the semiconductor substrate 3, the arrangement relation can be adjusted so that it may be in a suitable state. Since the arrangement relation of each portion can be adjusted only by moving a flat-surface top, tuning is easy and, moreover, can adjust with a sufficient precision.
[0046] In addition, only the sub mounting 6 in which the semiconductor laser chip 7 is mounted may be moved to the direction of X, and a Z direction, and the above-mentioned adjustment may be performed.
[0047] Here, since the semiconductor laser chip 7 is mounted in the sub mounting 6, generally, an insulating layer is formed in surface 6a of the sub mounting 6, and the semiconductor laser chip 7 is mounted through this. However, in order to simplify structure, it is desirable to omit an insulating layer. In this case, what is necessary is just to set up the cathode of the semiconductor laser chip 7, and the anode of the photo diode 9 formed in the semiconductor substrate 3 so that it may become common potential.
[0048] Next, in the semiconductor laser module 1 of this example, as shown in drawing 1 (B), the circuit portions 12, such as a I/V conversion circuit which changes the detection output current from each photo diodes 7 and 8 into the periphery portion of the semiconductor substrate 3 at voltage, can be made according to a semiconductor manufacture process. For example, the digital disposal circuit shown in above-mentioned drawing 6 can be made. If it does in this way, compared with the case where external [of these digital disposal circuits] is carried out, a semiconductor laser unit can be constituted in a small compact. Moreover, wiring between a light sensing portion and a conversion circuit can be shortened, and improvement in S/N can be aimed at.
[0049] In the semiconductor laser module 1 of this example as mentioned above (Effect of the semiconductor laser module of drawing 1) To surface 3a of the semiconductor substrate 3 from which the photo diode group 9 for focusing error detection, tracking-error detection, and FR (pit) signal detection was made The prism 4 with which the reflector 5 for leading the main beam L1 generated from the semiconductor laser chip 7 to the optical recording medium 31 side through a hologram 35 and objective lens 34 grade was formed, The composition which has arranged the sub mounting 6 and has arranged the semiconductor laser chip 7 and the photo diode 8 for monitors on surface 6a of this sub mounting 4 is adopted.
[0050] Therefore, the semiconductor laser chip 7 and photo diode 8 are arranged at surface 6a of the sub mounting 6. Moreover, the terminal pad 11 for external connection of the photo diode group 9 made by the semiconductor substrate 3 is formed in the substrate surface 3a concerned. Thus, the portion for bonding is arranged or formed on the coplanar or the parallel flat surface. Therefore, the work which connects these electrically to a lead pin etc. by wirebonding becomes easy. Moreover, the yield also becomes good. Furthermore, since there is no need of using an expensive bonding machine, it is advantageous also to reduction-izing of an equipment price.
[0051] On the other hand, moving the both sides of the sub mounting 6 by which the prism 4 arranged on surface 3a of the semiconductor substrate 3 and the semiconductor laser chip 7 were mounted along with the surface 3a concerned, or by moving only the sub mounting 6 in which the semiconductor laser chip 7 was mounted along with the surface 3a concerned, positioning of each portion can be performed so that focal offset may not arise. Therefore, this adjustment can be performed easily.
[0052] (Modification of a semiconductor laser module) The modification of the above-mentioned semiconductor laser module 1 is shown in drawing 7 . The semiconductor laser module 40 of fundamental composition shown in this drawing is the same as the above-mentioned module 1. The photo diode 41 for monitors is also made from the semiconductor laser module 40 of this example to the semiconductor substrate 3. And the incident light L3 which carried out refraction incidence into prism through the reflector 5 formed in prism 4 irradiates the light-receiving side 41a.
[0053] Here, unless the degree of incident angle of an incident light L3 fulfills a predetermined angle, an incident light L3 may carry out total reflection on the base of prism 4, and an incident light L3 may not reach light-receiving side 41a of the photo diode 41 for monitors. In order to avoid such a phenomenon, it is good to apply the adhesives which prevent total reflection between the base of prism 4 and light-receiving side 41a of the photo diode 41 for monitors, and to carry out adhesion fixation of prism 4 and the semiconductor substrate 3. Or you may give AR coat (antireflection film) beforehand to the base of prism 4.
[0054] In addition, since the composition of those other than this is the same as that of the semiconductor laser module 1 shown in drawing 1 , those explanation is omitted.
[0055] Thus, when the constituted semiconductor laser module 40 is used, the same operation effect as the case of the semiconductor laser module 1 which above-mentioned drawing 1 shows can be acquired.
[0056] In addition, as for the property of the reflector 5 formed in those prism 4, in the semiconductor laser modules 1 and 40 shown in drawing 1 and drawing 7 , it is desirable to set up as follows. Namely, what is necessary is just to form a reflector 5 by the diffusion shell in the case of the use which does not need the quantity of light so much like CD. On the other hand, what is necessary is to reflect more outgoing radiation light L1 (for it to be s-polarized light light as opposed to a reflector 5) from the semiconductor laser chip 7 in the case of the use which needs many quantity of lights like DVD, and just to form in it with the polarization film equipped with the property of making more return light Lr (plane of polarization rotating 90 degrees

and serving as p-polarized light light to the reflector 5 with lambda/4 board.) penetrating.
[0057] Moreover, in the above-mentioned semiconductor laser modules 1 and 40, prism 4 is made into the configuration which made only the portion in which the reflector 5 is formed project, and the return light Lr irradiates directly photo diodes 92 other than photo diode 91 located in the center among the photo diode groups 9 for signal processing, or 95. When the return light Lr passes prism 4, astigmatism, comatic aberration, etc. arise and there is a possibility that a detection error may occur in photo diode 92 or 95. Such evil is not generated in each above-mentioned example. In addition, since the central photo diode 91 has only detected only the so-called existence of light as mentioned above, even if it returns through prism 4 and detects Light Lr, the detection error resulting from astigmatism, comatic aberration, etc. does not pose a problem.
[0058] However, if such a detection error is removable by the option, in the case of the use from which such a detection error does not pose a problem, it can consider as the thing of the simple configuration by which the reflective film was formed there by making into an inclined plane one side in which fixed thickness is monotonous as prism 4.
[0059] Semiconductor laser module 40A equipped with prism 4A of this form is shown in drawing 8 . In this case, in all the photo diode groups 9 made by the semiconductor substrate 3, it will be covered by prism 4A.
[0060] (Another example of an optical pickup) Another example of the optical system of an optical pickup with which the semiconductor laser module 1 was incorporated is shown in drawing 9 . In the optical system shown in this drawing, the hologram element 32 of the same composition as the above is arranged between the total reflection mirror 37 and 1/4 wavelength plate 33. Therefore, an optical path is risen by the total reflection mirror 37, and the outgoing radiation light from the semiconductor laser module 1 is led to the hologram element 32. Outgoing radiation light is diffracted by the hologram element 32, and is divided into five light beams, and division light is led to an objective lens 34 through 1/4 wavelength plate 33, and is converged as five optical spots on [of the recording surface of the optical recording medium 31]. The return light reflected from the recording surface of the optical recording medium 31 results in 1/4 wavelength plate 33 through an objective lens 34, passes through this, and plane of polarization rotates it 90 degrees. Therefore, the hologram element 32 which diffracts only specific polarization is passed, and it results in the total reflection mirror 37, it is reflected here, and return light returns to the semiconductor laser module 1. Photodetection operation in this example is the same as that of the above-mentioned case.
[0061]
[Effect of the Invention] As explained above, the semiconductor laser module of this invention has the composition that the parts which need bondings which are components, such as a semiconductor laser chip and a photo diode chip, and the pad for external connection of a circuit portion made on the semiconductor substrate were located on the coplanar or the parallel flat surface. Therefore, according to this invention, unlike a case as each part article is mounted on the flat surface which intersects perpendicularly like before, bonding work can be done easily and the yield can also be improved. Moreover, since a bonding machine can also use a cheap thing, reduction-ization of an equipment price can also be attained.

[Translation done.]

* NOTICES *

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TECHNICAL FIELD

[The technical field to which invention belongs] this invention relates to the semiconductor laser module of composition of that the laser light source and the photodetection section suitable for using it for the optical pickup for performing reproduction and record of an optical recording medium, or one [those] operation etc. were incorporated in one.
[0002]

[Translation done.]

PRIOR ART

[Description of the Prior Art] The optical pickup for reproducing optical recording media, such as a compact disk (CD), makes the recording surface of an optical recording medium condense the outgoing radiation light from the laser diode which is a laser light source through an objective lens, and has the composition of reading the return light from the recording surface concerned by the light sensitive cell. Moreover, the mechanism which can be amended minute is incorporated in the direction of a TORRA king, and the direction of focusing in the position of an objective lens so that outgoing radiation light may condense on the truck on a target recording surface correctly through an objective lens. In order to perform amendment of such a direction of tracking, and amendment of the direction of focusing, outgoing radiation light is diffracted with three beams, and it is made to acquire the servo control signal for tracking amendment, and the servo control signal for focusing amendment from the return light from an optical recording medium using diffraction gratings, such as a hologram optical element.

[0003] In order that an optical pickup may realize the small lightweight-ization, improvement is made about small lightweight-ization of a component. Among these, the composition which attained small lightweight-ization is proposed by attaching a laser light source and a light sensitive cell in one.

[0004] For example, the photo-detector package (semiconductor laser module) of composition of that a semiconductor laser chip and the photo diode which is a photo detector for tracking and focusing were enclosed in the package is indicated by JP,7-70065,B. In the photo-detector package indicated here, a heat sink is attached in the front face of a stem to which the lead pin has come out from the rear-face side, and the photo diode chip and the semiconductor laser chip are arranged at the upper surface and the side of this heat sink, respectively. The electrode of each of these chips is electrically connected to the lied terminal arranged at the periphery of a heat sink etc. by wirebonding, and transfer of a signal is performed between external circuits through the lead pin by the side of a stem rear face.

[Translation done.]

EFFECT OF THE INVENTION

In the semiconductor laser module 1 of this example as mentioned above (Effect of the semiconductor laser module of drawing 1) To surface 3a of the semiconductor substrate 3 from which the photo diode group 9 for focusing error detection, tracking-error detection, and FR (pit) signal detection was made The prism 4 with which the reflector 5 for leading the main beam L1 generated from the semiconductor laser chip 7 to the optical recording medium 31 side through a hologram 35 and objective lens 34 grade was formed, The composition which has arranged the sub mounting 6 and has arranged the semiconductor laser chip 7 and the photo diode 8 for monitors on surface 6a of this sub mounting 4 is adopted.

[0050] Therefore, the semiconductor laser chip 7 and photo diode 8 are arranged at surface 6a of the sub mounting 6. Moreover, the terminal pad 11 for external connection of the photo diode group 9 made by the semiconductor substrate 3 is formed in the substrate surface 3a concerned. Thus, the portion for bonding is arranged or formed on the coplanar or the parallel flat surface. Therefore, the work which connects these electrically to a lead pin etc. by wirebonding becomes easy. Moreover, the yield also becomes good. Furthermore, since there is no need of using an expensive bonding machine, it is advantageous also to reduction-izing of an equipment price.

[0051] On the other hand, moving the both sides of the sub mounting 6 by which the prism 4 arranged on surface 3a of the semiconductor substrate 3 and the semiconductor laser chip 7 were mounted along with the surface 3a concerned, or by moving only the sub mounting 6 in which the semiconductor laser chip 7 was mounted along with the surface 3a concerned, positioning of each portion can be performed so that focal offset may not arise. Therefore, this adjustment can be performed easily.

[0052] (Modification of a semiconductor laser module) The modification of the above-mentioned semiconductor laser module 1 is shown in drawing 7 . The semiconductor laser module 40 of fundamental composition shown in this drawing is the same as the above-mentioned module 1. The photo diode 41 for monitors is also made from the semiconductor laser module 40 of this example to the semiconductor substrate 3. And the incident light L3 which carried out refraction incidence into prism through the reflector 5 formed in prism 4 irradiates the light-receiving side 41a.

[0053] Here, unless the degree of incident angle of an incident light L3 fulfills a predetermined angle, an incident light L3 may carry out total reflection on the base of prism 4, and an incident light L3 may not reach light-receiving side 41a of the photo diode 41 for monitors. In order to avoid such a phenomenon, it is good to apply the adhesives which prevent total reflection between the base of prism 4 and light-receiving side 41a of the photo diode 41 for monitors, and to carry out adhesion fixation of prism 4 and the semiconductor substrate 3. Or you may give AR coat (antireflection film) beforehand to the base of prism 4.

[0054] In addition, since the composition of those other than this is the same as that of the semiconductor laser module 1 shown in drawing 1 , those explanation is omitted.

[0055] Thus, when the constituted semiconductor laser module 40 is used, the same operation effect as the case of the semiconductor laser module 1 which above-mentioned drawing 1 shows can be acquired.

[0056] In addition, as for the property of the reflector 5 formed in those prism 4, in the semiconductor laser modules 1 and 40 shown in drawing 1 and drawing 7 , it is desirable to set up as follows. Namely, what is necessary is just to form a reflector 5 by the diffusion shell in the case of the use which does not need the quantity of light so much like CD. On the other hand, what is necessary is to reflect more outgoing radiation light L1 (for it to be s-polarized light light as opposed to a reflector 5) from the semiconductor laser chip 7 in the case of the use which needs many quantity of lights like DVD, and just to form in it with the polarization film equipped with the property of making more return light Lr (plane of polarization rotating 90 degrees and serving as p-polarized light light to the reflector 5 with lambda/4 board.) penetrating.

[0057] Moreover, in the above-mentioned semiconductor laser modules 1 and 40, prism 4 is made into the configuration which made only the portion in which the reflector 5 is formed project, and the return light Lr irradiates directly photo diodes 92 other than photo diode 91 located in the center among the photo diode groups 9 for signal processing, or 95. When the return light Lr passes prism 4, astigmatism, comatic aberration, etc. arise and there is a possibility that a detection error may occur in photo diode 92 or 95. Such evil is not generated in each above-mentioned example. In addition, since the central photo diode 91 has only detected only the so-called existence of light as mentioned above, even if it returns through prism 4 and detects Light Lr, the detection error resulting from astigmatism, comatic aberration, etc. does not pose a problem.

[0058] However, if such a detection error is removable by the option, in the case of the use from which such a detection error does not pose a problem, it can consider as the thing of the simple configuration by which the reflective film was formed there by making into an inclined plane one side in which fixed thickness is monotonous as prism 4.

[0059] Semiconductor laser module 40A equipped with prism 4A of this form is shown in drawing 8 . In this case, in all the photo diode groups 9 made by the semiconductor substrate 3, it will be covered by prism 4A.
[0060] (Another example of an optical pickup) Another example of the optical system of an optical pickup with which the semiconductor laser module 1 was incorporated is shown in drawing 9 . In the optical system shown in this drawing, the hologram element 32 of the same composition as the above is arranged between the total reflection mirror 37 and 1/4 wavelength plate 33. Therefore, an optical path is risen by the total reflection mirror 37, and the outgoing radiation light from the semiconductor laser module 1 is led to the hologram element 32. Outgoing radiation light is diffracted by the hologram element 32, and is divided into five light beams, and division light is led to an objective lens 34 through 1/4 wavelength plate 33, and is converged as five optical spots on [of the recording surface of the optical recording medium 31]. The return light reflected from the recording surface of the optical recording medium 31 results in 1/4 wavelength plate 33 through an objective lens 34, passes through this, and plane of polarization rotates it 90 degrees. Therefore, the hologram element 32 which diffracts only specific polarization is passed, and it results in the total reflection mirror 37, it is reflected here, and return light returns to the semiconductor laser module 1. Photodetection operation in this example is the same as that of the above-mentioned case.

[Translation done.]

* NOTICES *

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] In the semiconductor laser module of the above-mentioned composition, the semiconductor laser chip is attached in the side which intersects perpendicularly to the front face of the heat sink with which the photo diode chip has been arranged. In wirebonding, even if the difference of elevation is in the flat surface in which the parts for bonding are attached, when those fields are parallel, it does not become almost at the hindrance of mounting work.
[0006] However, when the parts for bonding are attached in the front face which is not parallel, respectively, in the bonding of these parts, it is necessary to change the posture of a bonding machine according to it. For example, when the phot die auto chip and semiconductor laser chip for bonding are arranged on the flat surface which intersects perpendicularly as mentioned above, after carrying out bonding of one near parts, it is necessary to change the posture of a bonding machine 90 degrees and to perform bonding of the remaining parts. Or it is necessary to mount in the field which intersects perpendicularly using the complicated bonding machine equipped with the capillary tube in which bonding is possible.
[0007] Thus, since the work is difficult, not to mention carrying out a yield fall, carrying out bonding of the parts arranged on the flat surface which is not parallel will take mounting time mostly, and it will become the hindrance of reduction-izing of a product price.
[0008] The technical problem of this invention is to propose the semiconductor laser module equipped with the possible composition of canceling such a conventional trouble.

[Translation done.]

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MEANS

[Means for Solving the Problem] In order to solve the above-mentioned technical problem, it is made for the next composition to be used for this invention in the semiconductor laser module which has a semiconductor laser chip, the reflector which reflects the laser beam by which outgoing radiation was carried out from the semiconductor laser chip concerned, the photo detector for signal processing which receives the return light of the aforementioned laser beam, and the photo detector for monitors which receives the laser beam by which outgoing radiation was carried out from the aforementioned semiconductor laser chip. Namely, the semiconductor substrate equipped with the flat front face and prism equipped with the aforementioned reflector which has been arranged on the front face of the semiconductor substrate concerned, and inclined 45 abbreviation to the front face concerned, Sub mounting which has been arranged on the front face of the aforementioned semiconductor substrate so that face to face may be stood against the aforementioned reflector of the prism concerned, and was equipped with the front face parallel to the front face of the semiconductor substrate concerned, The aforementioned semiconductor laser chip arranged on the front face of the aforementioned sub mounting so that the main laser beam may be irradiated to the aforementioned reflector of the aforementioned prism, The aforementioned photo detector for monitors arranged on the front face of the aforementioned sub mounting so that the sublaser beam by which outgoing radiation is carried out from the semiconductor laser chip concerned may be received, The composition which has the aforementioned photo detector for signal processing made by the semiconductor substrate concerned so that at least one light-receiving side might be formed in the front face of the aforementioned semiconductor substrate located directly under the reflector of the aforementioned prism is adopted.
[0010] Moreover, the semiconductor substrate which the semiconductor laser module of this invention equipped with the flat front face instead of the above-mentioned composition, The prism equipped with the aforementioned reflector which has been arranged on the front face of the semiconductor substrate concerned, and inclined 45 degrees to the front face concerned, Sub mounting which has been arranged on the front face of the aforementioned semiconductor substrate so that face to face may be stood against the aforementioned reflector of the prism concerned, and was equipped with the front face parallel to the front face of the semiconductor substrate concerned, The aforementioned semiconductor laser chip arranged on the front face of the aforementioned sub mounting so that the main laser beam may be irradiated to the aforementioned reflector of the aforementioned prism, The aforementioned photo detector for monitors made by the semiconductor substrate concerned so that a light-receiving side might be located in the irradiation field of the front face of the aforementioned semiconductor substrate by the incident-light component of the main laser beam which carried out incidence into the aforementioned prism through the aforementioned reflector, The composition which has the aforementioned photo detector for signal processing made by the semiconductor substrate concerned so that at least one light-receiving side might be formed in the front face of the aforementioned semiconductor substrate located directly under the reflector of the aforementioned prism is adopted.
[0011] Thus, in the semiconductor laser module of the constituted this invention, each component part can be arranged on an parallel flat surface. Therefore, by easy work, the yield is good and, moreover, bonding of each component part can be performed in a short time. For this reason, it is advantageous also to reduction-izing of an equipment price.
[0012]
[Embodiments of the Invention] The semiconductor laser module which applied this invention to below with reference to the drawing is explained.
[0013] As shown in drawing 1 , the semiconductor laser module 1 of this invention is enclosed with a package 20, and is used as a semiconductor laser unit. Of course, it may use without carrying out the closure packaging of the laser module 1. The package 20 of this example is equipped with the support substrate (stem) 21, and the cup-like cap 22 for closure who attached on this. The semiconductor laser module 1 which applied this invention on the front face of the support substrate 21 is carried in the closure space formed of these. The lead pin 23 is attached in the stem 21, and transfer of a signal is performed through the lead pin group 23 between each component of the semiconductor laser module 1 and the exteriors which are enclosed.
[0014] The semiconductor laser module 1 is equipped with the semiconductor substrate 3 arranged on the front face of the support substrate 21, and this front face has become flat field 3a. Prism 4 is arranged at this flat surface 3a. the right angle from the center of rectangle board partial 4a of thickness with fixed prism 4, and side 4b of one of these -- a protrusion -- it has lobe part 4c the bottom, the upper surface of this lobe part 4c is made into the slant face which makes the angle of 45 degrees to surface 3a of the semiconductor substrate 3, and this slant face is the reflector in which the reflective film 5 was formed The degree of tilt angle of a reflector does not need to be 45 degrees strictly, and should just be 45 degrees in general. Let prism 4 be glass mould parts or resin mould parts.

[0015] The plate-like sub mounting 6 which functions as a heat sink is arranged in the position of semiconductor substrate surface 3a which stands face to face against this reflective film 5. The upper surface of this sub mounting 6 is semiconductor substrate surface 3a and parallel flat surface 6a. The semiconductor laser chip 7 is arranged at the near portion of the reflector 5 in this surface 6a. The emitting [main laser beam] light point 7a stands face to face against the reflector 5 so that the semiconductor laser chip 7 may serve as sense in which the main laser beam L1 by which outgoing radiation is carried out carries out incidence from there at the angle of 45 degrees to a reflector 5.
[0016] The photo diode chip 8 as a photo detector for monitors is arranged at the portion of surface 6a of the sub mounting 6 by the side of the tooth back of the semiconductor laser chip 7. With this photo diode chip 8, the sublaser beam L2 which carries out outgoing radiation from the semiconductor laser chip 7 can be received.
[0017] The semiconductor substrate 3 is a photo diode substrate for constituting the photo detector for signal processing, and the photo diode 91 for a semiconductor manufacture process detecting a pit signal from the return light Lr from an optical recording medium and four photo diodes 92, 93, 94, and 95 of two assembled dies arranged by the both sides of this photo diode 91 are formed here. Light-receiving side 91a of the photo diode 91 located in the center such photo diodes 91 or among 95 is formed in the portion of surface 3a of the semiconductor substrate 3 located directly under the reflector 5 of prism 4. Thus, in this example, it has five photo diodes 91 or 95 as a photo detector for signal processing.
[0018] Here, the terminal pad group 11 for taking out photo diode 91 or the output from 95 is formed in the periphery portion of surface 3a of the semiconductor substrate 3, and each of these terminal pad groups 11 is electrically connected to the lead pin by which two or more lead pin groups 23 attached in the state where the periphery portion of a support plate (stem) 21 was penetrated by wirebonding 24 correspond.
[0019] Moreover, the photo diode chip 8 and the semiconductor laser chip 7 are also electrically connected to the lead bottle by which it corresponds of the lead pin groups 23 by wirebonding 25, and a signal is taken out outside through a lead pin group, or power is supplied from the exterior.
[0020] (Optical pickup) An example of the optical system of an optical pickup with which the semiconductor laser module 1 of the above-mentioned composition was incorporated is shown in drawing 2 .
[0021] In the optical system of the optical pickup of this example, the straight-line-like optical path is formed between the semiconductor laser units 30 and the optical recording media 31 by which the semiconductor laser module 1 was built in. the optical-path top of the shape of this straight line -- the hologram element 32 from a side, 1/4 wavelength plate 33, and objective lens 34 of the semiconductor laser module 1 -- this sequence -- an array -- now, it is The hologram element 32 is formed in the optical axis Lo and the front face of the glass substrate 35 arranged mostly at the perpendicular.
[0022] It is reflected right-angled by the reflector 5 by which opposite arrangement is carried out, and outgoing radiation of the main laser beam L1 by which outgoing radiation was carried out from the semiconductor laser chip 7 in the semiconductor laser module 1 is carried out from the semiconductor laser unit 30 towards the direction which met the optical axis Lo. The main laser beam L1 passes a glass substrate 35, and is divided into five light beams by the hologram element 32. Such division light is led to an objective lens 34 through 1/4 wavelength plate 33, and converges as five optical spots on the recording surface of the optical recording medium 31 through an objective lens 34.
[0023] It is reflected by the recording surface and the return light Lr of five light beams reflected by the recording surface of a record medium 31 passes 1/4 wavelength plate 33 through an objective lens 34 again. It returns by 1/4 wavelength plate 33, and plane of polarization rotates light 90 degrees. Therefore, the hologram element 32 is passed as it is, and it returns to the semiconductor laser module 1 through a glass substrate 35.
[0024] Five light beams which returned to the semiconductor laser module 1 are detected by five photo diodes 91 currently formed in the semiconductor substrate 3, or 95, and a focusing error signal, a tracking error signal, and RF signal are detected. Here, since the reflector 5 is formed in right above [of the central photo diode 91], the light which passed the reflector 5 will irradiate this photo diode 91.
[0025] On the other hand, the sublaser beam L2 which carried out outgoing radiation from the tooth-back side of the semiconductor laser chip 7 irradiates the photo diode 8 for monitors by which opposite arrangement is carried out at the tooth-back side of the semiconductor laser chip 7, and is detected here. Based on the detecting signal of this photo diode 8, the output control of the semiconductor laser chip 7 is performed. That is, quantity of light adjustment of the outgoing radiation light L1 is performed.
[0026] Thus, in this example, the signal detection is performed by dividing outgoing radiation light into five light beams with the hologram element 32.
[0027] With reference to drawing 3 or drawing 6 , an operation of the hologram element 32 and a signal-detection principle are explained.
[0028] First, as shown in drawing 3 , the hologram element 32 is halved by the parting line prolonged in the direction which meets the truck of a record medium 31 on an optical axis Lo mostly, and the direction which intersects perpendicularly. The diffraction gratings (irregularity-like grid) 32A and 32B of a couple with which diffraction conditions differ bordering on this parting line are formed. As for these diffraction gratings 32A and 32B, the lattice spacing differs from the direction of a grid.
[0029] It explains as which position on a recording surface it is completed by the light beam of diffraction zero-order and the primary diffraction by operation of this hologram element 32 using the principle view of drawing 3 . The zero-order light which is not diffracted among the light beams which carried out outgoing radiation from the semiconductor laser module 1, and which carried out incidence to upper hologram element 32A passes diffraction-grating 32A, it carries out incidence to an objective lens 34, and it is converged on point L'. Incidence of it is carried out to an objective lens 34 as if the primary

diffraction light which received diffraction had the light source in virtual-image A+ which is in the optical-axis symmetry centering on the position L of the semiconductor laser module 1, and A-, and it is converged on point A'+, A'-. namely, the light beam which carried out outgoing radiation of the diffraction-grating 32A -- an objective lens 34 -- zero-order light -- being related -- L and conjugate point L' -- primary light -- being related -- A+, and conjugate-point A'+, A'- ** -- it converges on the position (conjugate point) where it corresponded on the recording surface, respectively [of A-]

[0030] The light beam which carried out outgoing radiation from the semiconductor laser module 1 and which carried out incidence to diffraction-grating 32B of the drawing 6 bottom can completely be considered to be this the same way. About primary light, it converges on point L' [conjugate / light / zero-order] as L / at B+, and conjugate-point B'+, B'-, respectively. / of B- Therefore, after the outgoing radiation light of the semiconductor laser module 1 serves as diffraction zero-order and a light beam of the primary diffraction and passes an objective lens 34 by operation of the diffraction gratings 32A and 32B of the upper and lower sides of the hologram element 32, it will be converged on the recording surface of the optical recording medium 31 as five optical spots of L', A'+, A'-, and B'+, B'-.

[0031] Signs that the optical spot formed was perpendicularly seen to the recording surface of the optical recording medium 31 are shown in drawing 4 . The optical spot 100 of the center of a truck 311 is diffraction zero-order light, and four points of others are the primary [**] diffracted lights. In addition, the light beam which passed the portion in which a diffraction grating is not formed with the hologram element 32 is converged on the same optical spot as diffraction zero-order light. Here, the primary diffraction light spots 101 and 103 of diffraction-grating 32A become the position of a point symmetry to the main optical spot 100, and the primary diffraction light spots 102 and 104 of diffraction-grating 32B also become the position of a point symmetry to the main optical spot 100. Each spot position can complete each primary diffracted light as the suitable position of a truck by appointing each lattice spacing and direction of a grid of each diffraction gratings 32A and 32B. Moreover, the outline configuration of the optical spot of these primary diffraction light is acquired as the Fourier transform of each diffraction-grating opening configuration.

[0032] Next, the optical spot received in the photo diode 9 (91 or 95) which is a light sensitive cell is explained. It reflects by the optical recording medium 31, and the optical spot on the recording surface of the optical recording medium 31 passes an objective lens 34 again, and it carries out re-image formation by the near focal plane of photo diode 9. The physical relationship of the optical spot in the near focal plane of photo diode 9 turns into the physical relationship and the conjugate relation of an optical spot on a recording surface. Therefore, when the physical relationship of an objective lens 34 and the optical recording medium 31 moves in the direction which intersects perpendicularly with the direction of an optical axis, or an optical axis, a spot position and a spot configuration change similarly on a recording surface and the focal plane by the side of the photo diode group 8.

[0033] With reference to drawing 5 , change of the direction of an optical axis of the physical relationship of an objective lens 34 and the optical recording medium 31, i.e., change of the near optical spot of the photo diode 9 to a focal gap, is explained.

[0034] At the focusing point, as shown in drawing 9 (B), focusing on the optical spot 200 of zero-order light, the optical spots 201 and 203 of the primary diffraction light of diffraction-grating 32A and the optical spots 202 and 204 of the primary diffraction light of diffraction-grating 32B are located up and down, and all form the minimum optical spot. And it is located at the center of the parting line of 2 division photo diode 92 or 2 division light-receiving side of 95 where the optical spot 201 of primary diffraction light or 204 arranged the optical spot 200 in the single tier at the both sides of photo diode 91 at the center of light-receiving side 91a of the central photo diode 91.

[0035] On the other hand, when the distance of an objective lens 34 and the optical recording medium 31 approaches, as shown in drawing 5 (A), the optical spot 200 of zero-order light does not have change of a position, and a path becomes large. while the optical spots 201 and 203 of the primary diffraction light of diffraction-grating 32A become large in the form similar to the opening configuration of diffraction-grating 32A -- the center -- the drawing 5 top -- moving .

[0036] The center moves the optical spots 202 and 204 of the primary diffraction light of diffraction-grating 32B to the drawing 5 bottom, becoming large in the form similar to the opening configuration of diffraction-grating 32B. Consequently, as for the optical spot 201 of primary diffraction light, or 204, most will be located in each one side of 2 division photo diode 92 or 95. In addition, since drawing 5 has shown the ideal state, although the optical spot is located only in one side, a part is located also in an another side side by dotage etc. in practice.

[0037] With the above, when the distance of an objective lens 34 and an optical recording medium becomes far conversely, as shown in drawing 5 (C), the optical spot 200 of zero-order light does not have change of a position, and a path becomes large. the optical spots 201 and 203 of the primary diffraction light of diffraction-grating 32A -- the upper and lower sides of diffraction-grating 32A -- while becoming large in the form similar to the reverse opening configuration -- the center -- the drawing 5 bottom -- moving . The center moves the optical spots 202 and 204 of the primary diffraction light of diffraction-grating 32B to the drawing 5 bottom, becoming large in the form similar to the opening configuration of the vertical reverse of diffraction-grating 32B.

[0038] Therefore, if it is made for a comparator 403 to compare the result for the output of 2 division photo diodes 92 and 93, and the output of 2 division photo diodes 94 and 95 by comparators 401 and 402 among each photo diode 91 or the output of 95 as compared with vertical reverse, respectively as shown in drawing 6 , a focusing error signal (FE signal) can be obtained.

[0039] On the other hand, it is the same as that of the usual 3 beam method, and as shown in drawing 6 , a tracking error signal (TE signal) can be acquired by adding the output of 2 division photo diodes 92 and 93, and the output of 2 division photo diodes 94 and 95 with adders 404 and 405, respectively, and comparing the result by the comparator 406. But a

tracking error signal can obtain at least the output of 2 division photo diodes 92 and 94, or the output of 2 division photo diodes 93 and 95.

[0040] In addition, about RF signal, according to the grade of focusing, it is only that the beam diameter of zero-order light fluctuates, and the spot is always located on the light-receiving side of photo diode 91. Detection of RF signal is performed based on the output of this photo diode 91.

[0041] Here, the method of adjusting the arrangement position of each portion of the semiconductor laser module 1 is explained.

[0042] In the optical system of the optical pickup of the above-mentioned composition, the physical relationship between emitting light point 7a of the semiconductor laser chip 7 and the light-receiving side of the photo diode group 9 for signal processing turns into conjugate physical relationship optically. That is, the optical path lengths a and b in drawing 1 (A) become equal length. If these portions shift from the position which has a conjugate relation, the so-called focal offset from which the zero position of the point and a focal error signal where the modulation intensity of FR (pit) signal serves as the highest shifts will arise.

[0043] Adjust the optical path length a, and it is made for this to serve as the optical path length b and a conjugate relation, and is made to fix prism 4 to the position where the conjugate relation was materialized in the semiconductor laser module 1 of this example by setting prism 4 on surface 3a of the semiconductor substrate 3, and making it move in the direction (Z direction of drawing 1) approached and estranged to the semiconductor laser chip 7. Thus, whenever it adjusts, when a thickness error is in the sub mounting 6, it can be compensated, and both portions can be set as the position used as a conjugate relation, for example.

[0044] Moreover, in order to make it focal offset not occur, the above-mentioned case is required also for positioning of the semiconductor laser chip 7 in the direction (the direction of X of drawing 1) which intersects perpendicularly. for this reason -- being alike -- what is necessary is to be in the state where the semiconductor laser chip 7 was made to emit light, to turn this in the direction of X together with the sub mounting 6, and just to move it so that the spot of each beam of the return light Lr may be located at the center on the parting line in the halved type photo diode 92 or the light-receiving side of 95

[0045] Thus, in the semiconductor laser module 1 of this example, by moving all around the prism 4 and the sub mounting 6 which are arranged to flat surface 3a of the semiconductor substrate 3, the arrangement relation can be adjusted so that it may be in a suitable state. Since the arrangement relation of each portion can be adjusted only by moving a flat-surface top, tuning is easy and, moreover, can adjust with a sufficient precision.

[0046] In addition, only the sub mounting 6 in which the semiconductor laser chip 7 is mounted may be moved to the direction of X, and a Z direction, and the above-mentioned adjustment may be performed.

[0047] Here, since the semiconductor laser chip 7 is mounted in the sub mounting 6, generally, an insulating layer is formed in surface 6a of the sub mounting 6, and the semiconductor laser chip 7 is mounted through this. However, in order to simplify structure, it is desirable to omit an insulating layer. In this case, what is necessary is just to set up the cathode of the semiconductor laser chip 7, and the anode of the photo diode 9 formed in the semiconductor substrate 3 so that it may become common potential.

[0048] Next, in the semiconductor laser module 1 of this example, as shown in drawing 1 (B), the circuit portions 12, such as a I/V conversion circuit which changes the detection output current from each photo diodes 7 and 8 into the periphery portion of the semiconductor substrate 3 at voltage, can be made according to a semiconductor manufacture process. For example, the digital disposal circuit shown in above-mentioned drawing 6 can be made. If it does in this way, compared with the case where external [of these digital disposal circuits] is carried out, a semiconductor laser unit can be constituted in a small compact. Moreover, wiring between a light sensing portion and a conversion circuit can be shortened, and improvement in S/N can be aimed at.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The side block diagram showing the arrangement relation of each component of the semiconductor laser module with which (A) applied this invention, and (B) are the flat-surface block diagrams showing the plane configuration relation.
[Drawing 2] It is the outline block diagram showing the example of the optical system of an optical pickup with which the module of drawing 1 was incorporated.
[Drawing 3] It is explanatory drawing for explaining an operation of the hologram element of drawing 2 .
[Drawing 4] It is explanatory drawing showing the position of the optical spot formed on an optical recording medium.
[Drawing 5] It is explanatory drawing showing the state of the optical spot of the return light formed in the light-receiving side of photo diode.
[Drawing 6] It is the outline block diagram showing the circuitry for generating a focusing error signal, a tracking error signal, and RF signal based on the output of photo diode.
[Drawing 7] It is the side block diagram and flat-surface block diagram showing the modification of the semiconductor laser module of drawing 1 .
[Drawing 8] It is explanatory drawing showing the modification of the semiconductor laser module of drawing 7 with the optical system of an optical pickup.
[Drawing 9] It is the outline block diagram showing another example of the optical system of the optical pickup which can incorporate a semiconductor laser module.
[Description of Notations]
1 Semiconductor Laser Module
3 Semiconductor Substrate
3a The front face of a semiconductor substrate
4 Prism
5 Reflector Formed in Slant Face of Prism
6 Sub Mounting
6a The front face of sub mounting
7 Semiconductor Laser Chip
7a The point of the main laser beam emitting light
8 Photo Diode Chip for Monitors
91 or 95 Photo diode for signal processing
92a, 95a and 92b, or 95b Light-receiving side of 2 division photo diode
11 12 Terminal pad
23 Lead Bottle Group
24 25 Wirebonding
L1 Main laser beam
L2 Sublaser beam
Lr Return light
Lo Optical axis

[Translation done.]

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2.**** shows the word which can not be translated.
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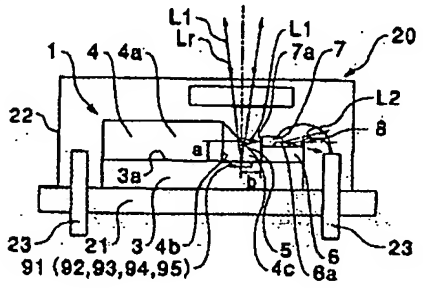
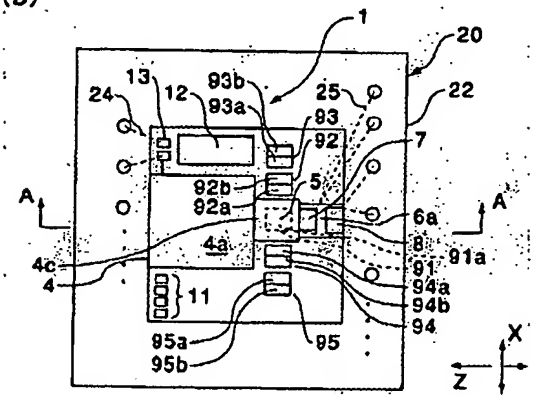
DRAWINGS

[Drawing 1]

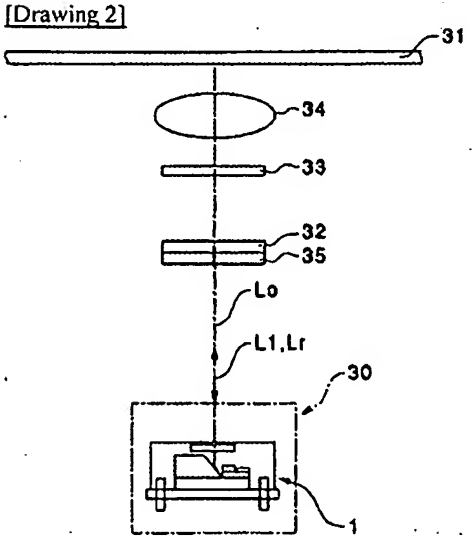
(A)



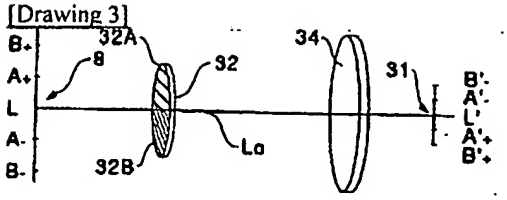
(B)



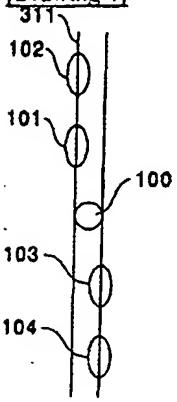
[Drawing 2]



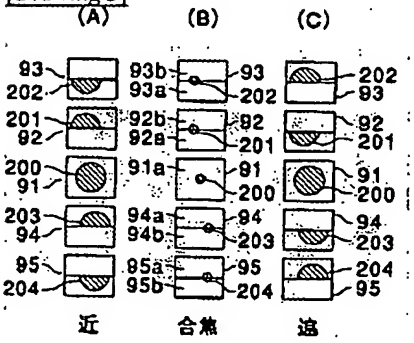
[Drawing 3]



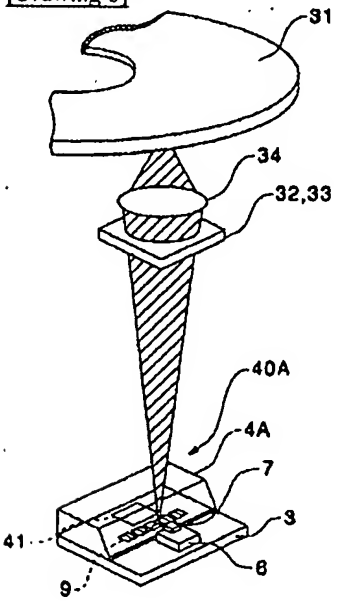
[Drawing 4]



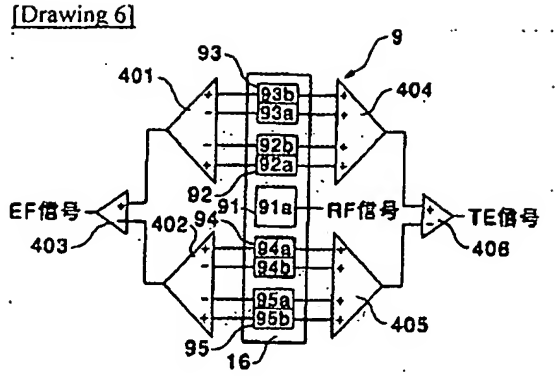
[Drawing 5]



[Drawing 8]

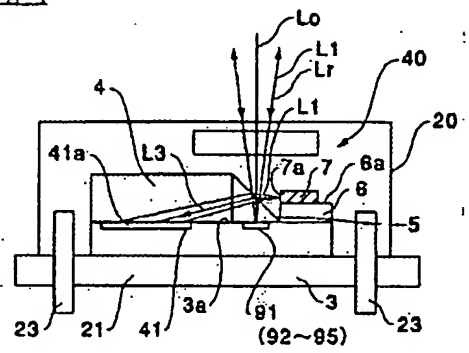


[Drawing 6]

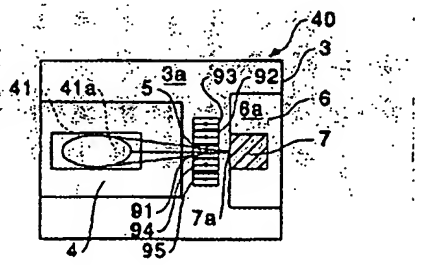


[Drawing 7]

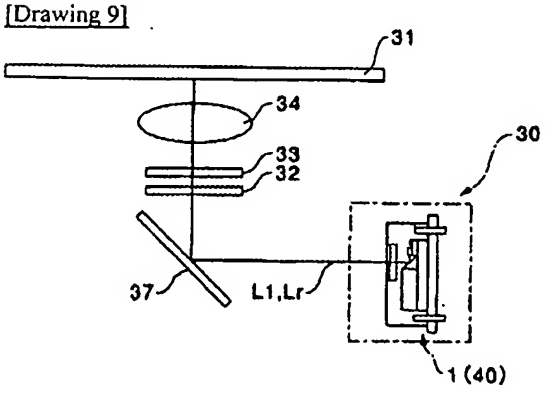
(A)



(B)



[Drawing 9]



[Translation done.]

* NOTICES *

CORRECTION or AMENDMENT

[Official Gazette Type] Printing of amendment by the convention of 2.of Article 17 of patent law
[Section partition] The 4th partition of the 6th section
[Date of issue] July 27, Heisei 13 (2001. 7.27)

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[The 7th edition of International Patent Classification]

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7/09

7/13
H01S 5/30

[FI]

G11B 7/135 Z
7/09 B
C
7/13
H01S 3/18

[Procedure revision]
[Filing Date] August 7, Heisei 12 (2000. 8.7)
[Procedure amendment 1]
[Document to be Amended] Specification
[Item(s) to be Amended] 0004
[Method of Amendment] Change
[Proposed Amendment]
[0004] For example, the photo-detector package (semiconductor laser module) of composition of that a semiconductor laser chip and the photo diode which is a photo detector for tracking and focusing were enclosed in the package is indicated by JP,7-70065,B. In the photo-detector package indicated here, a heat sink is attached in the front face of a stem to which the lead pin has come out from the rear-face side, and the photo diode chip and the semiconductor laser chip are arranged at the upper surface and the side of this heat sink, respectively. The electrode of each of these chips is electrically connected to the lead terminal arranged at the periphery of a heat sink etc. by wirebonding, and transfer of a signal is performed between external circuits through the lead pin by the side of a stem rear face.
[Procedure amendment 2]
[Document to be Amended] Specification
[Item(s) to be Amended] 0021
[Method of Amendment] Change
[Proposed Amendment]
[0021] In the optical system of the optical pickup of this example, the straight-line-like optical path is formed between the semiconductor laser units 30 and the optical recording media 31 by which the semiconductor laser module 1 was built in. On the optical path of the shape of this straight line, the hologram element 32, 1/4 wavelength plate 33, and the objective lens 34 are arranged by this sequence from the semiconductor laser module 1 side. The hologram element 32 is formed in the optical axis Lo and the front face of the glass substrate 35 arranged mostly at the perpendicular.
[Procedure amendment 3]

[Document to be Amended] Specification
[Item(s) to be Amended] 0030
[Method of Amendment] Change
[Proposed Amendment]
[0030] The light beam which carried out outgoing radiation from the semiconductor laser module 1 and which carried out incidence to diffraction-grating 32B of the drawing 3 bottom can completely be considered to be this the same way. About primary light, it converges on point L' [conjugate / light / zero-order] as L / at B+, and conjugate-point B'+, B'-, respectively. / of B- Therefore, after the outgoing radiation light of the semiconductor laser module 1 serves as diffraction zero-order and a light beam of the primary diffraction and passes an objective lens 34 by operation of the diffraction gratings 32A and 32B of the upper and lower sides of the hologram element 32, it will be converged on the recording surface of the optical recording medium 31 as five optical spots of L', A'+, A'-, and B'+, B'-.
[Procedure amendment 4]
[Document to be Amended] Specification
[Item(s) to be Amended] 0034
[Method of Amendment] Change
[Proposed Amendment]
[0034] At the focusing point, as shown in drawing 5 (B), focusing on the optical spot 200 of zero-order light, the optical spots 201 and 203 of the primary diffraction light of diffraction-grating 32A and the optical spots 202 and 204 of the primary diffraction light of diffraction-grating 32B are located up and down, and all form the minimum optical spot. And it is located at the center of the parting line of 2 division photo diode 92 or 2 division light-receiving side of 95 where the optical spot 201 of primary diffraction light or 204 arranged the optical spot 200 in the single tier at the both sides of photo diode 91 at the center of light-receiving side 91a of the central photo diode 91.
[Procedure amendment 5]
[Document to be Amended] Specification
[Item(s) to be Amended] 0035
[Method of Amendment] Change
[Proposed Amendment]
[0035] On the other hand, when the distance of an objective lens 34 and the optical recording medium 31 approaches, as shown in drawing 5 (A), the optical spot 200 of zero-order light does not have change of a position, and a path becomes large. The center moves the optical spots 201 and 203 of the primary diffraction light of diffraction-grating 32A to the drawing 5 bottom, becoming large in the form similar to the opening configuration of diffraction-grating 32A.
[Procedure amendment 6]
[Document to be Amended] Specification
[Item(s) to be Amended] 0037
[Method of Amendment] Change
[Proposed Amendment]